CCSDS File Delivery Protocol (CFDP)

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AGENDA

- Why CFDP?
- What is it?
- How does it work?

(CCSDS = Consultative Committee for Space Data Systems)

Why CFDP? - Summary

- *Loads* and *Dumps* need improvement
- How? Use reliable file transfer protocol
- Which one?
  - Depends on your perspective
  - From NASA-wide perspective, use CFDP.

Why CFDP?

- *Loads* and *dumps* need improvement:
  - Individual commands use CCSDS Telecommand protocols; reusable code
  - Real-time telemetry uses CCSDS Telemetry protocols; reusable code
  - Commands *loads* (of on-board programs/tables) require *custom* code for most missions.
  - Telemetry *dumps* (of science data) require *custom* code for most missions.

Why CFDP?

- How to improve Loads and Dumps?
  - Loads and dumps are “file” transfers
  - Use a reliable file transfer protocol
  - Enables code reuse and increased automation

Why CFDP?

- Which file transfer protocol?
  - Mission manager perspective
    - One that works well for *my* mission
  - NASA-wide perspective
    - One that works well for *all* missions
    - Reusable (*stable* standard)
    - Compatible with *both* existing infrastructure and IP

Why CFDP? – Protocol comparison

Protocol	Missions?	Stable?	Exist+IP?
FTP	Some	Y	
CFDP	All	Y	Y
MDP	Some/All		
NORM	?		

Why CFDP? – Conclusion

- NASA-wide choice is CFDP
  - Works well for all missions (including near-Earth and Deep Space)
  - Stable (high probability of long-term reuse)
  - Compatible with both existing infrastructure and IP

What is CFDP? – Summary

- *Virtual Filesystem*
  - CFDP delivers a block of data and a "filename"
  - "Filename" maps to a *Virtual Filesystem*
  - One CFDP *node* per Virtual Filesystem
- Reliable file delivery
  - *Within* CFDP = Acknowledged Service
  - By a lower layer = Unacknowledged Service
- Point-to-point; extensions support multiple hops

What is CFDP? – Features

- Pause one transaction
- Pause all transactions (between passes)
- Filestore directives (e.g. rename file)
- Record-oriented files
- User Messages

What is CFDP? – Implementer's view

- Reusable core module
  - *Protocol engine*
- Implementation-specific interface modules
  - *User*
  - *Virtual Filesystem*
  - *Lower-layer communications*
    - IP-related issues restricted to this module
    - Extensive CFDP/UDP experience

How does it work? – Summary

- Transaction initiated by *Put Request* from User
- Sender transmits the whole file once.
  - Each "chunk" identifies its offset within file.
- For Acknowledged Service:
  - Repeat as necessary:
    - Receiver reports any gaps.
    - Sender retransmits gaps
  - Receiver reports "Finished"; Sender acknowledges.

How does it work? – First, Sender drives…

- *Metadata* →
  - Source, destination, filename
  - Optional: Filestore Directive(s)
  - Optional: User Messages
  - Optional: non-default error-handling
- *File-data* →
  - One per "chunk"; includes offset
- *EOF* →
  - Specifies file length, includes file checksum
- (for Unacknowledged Service, done)

How does it work? – … then Receiver drives.

- ← *Ack-EOF*
- ← *Nak*
  - Specifies missing data
  - (Deferred Nak; other modes exist)
- *File-data* → …
- ← *Finished*
- *Ack-Finished* →

How does it work? – Timers provide flexibility

- Ack-timer
  - Ensures EOF and Finished are delivered
  - Mission-configurable
- Nak-timer
  - Ensures feedback is provided periodically
  - Mission-configurable
- Transaction-lifetime-timer
  - Clears out zombies
  - Mission-configurable

How does it work? – User Requests

- *Put*
  - Starts a transaction.
- *Cancel*
  - Cancel one transaction.
- *Suspend/Resume*
  - Affects one transaction
- *Freeze/Thaw*
  - Pause *all* transactions (between passes).

References

- Web sites:
  - www.ccsds.org - CCSDS documents
  - www.ccsds.com - commercial support
- CFDP documents:
  - CCSDS 727.0-B-2 (protocol specs)
  - CCSDS 720.1-G-1 (explanation)
  - CCSDS 720.2-G-1 (Implementers Guide)
- For info on core CFDP:
  - Timothy.J.Ray@nasa.gov 301-286-0581
- For info on multi-hop scenarios:
  - Scott.Burleigh@jpl.nasa.gov

• NASA DATA SYSTEM STANDARDS PROGRAM •

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7. Next Generation Space Internet: Standards and Implementation: Keith Scott
8. Secure Space Networking: Howie Weiss
9. Delay Tolerant Networking: Scott Burleigh
10. CCSDS Link Layer Protocol Suite: Greg Kazz